Excitation Functions of Helion Induced Nuclear Reactions for the Production of the Medical Radioisotope ^{103}Pd

Yevgen Skakun[1], Syed M. Qaim[2]

[1] *National Science Center "Kharkiv Institute of Physics and Technology", 61108 Kharkiv, Ukraine; Institut für Nuklearchemie, Forschungszentrum Jülich GmbH, D-52425 Jülich, Germany ,*
[2] *Institut für Nuklearchemie, Forschungszentrum Jülich GmbH, D-52425 Jülich, Germany*

The radionuclide ^{103}Pd is of considerable medical interest. It has a half-life of 17 d and decays almost exclusively by EC. The emitted X-rays and Auger electrons are ideally suited for internal radiation therapy, especially for treatment of prostate cancer. For the production of ^{103} Pd, several methods have been reported. However, to date the ^{103}Rh(p,n)^{103}Pd reaction is most commonly used. In the present work we studied the hitherto uninvestigated helion induced reactions on enriched isotopes of ruthenium. Excitation functions of the nuclear reactions ^{100}Ru(α,n)^{103}Pd, ^{101}Ru(α,2n)^{103}Pd, ^{101}Ru(^{3}He,n)^{103}Pd and ^{102}Ru(^{3}He,2n)^{103}Pd were measured using the stacked-foil technique in combination with non-destructive high-resolution X-ray spectrometry. Thin (2-5 mg·cm^{-2}) metallic samples of highy enriched ruthenium isotopes ^{100}Ru, ^{101}Ru and ^{102}Ru were used as targets in the irradiation of the stacks with 27 MeV ^{4}He and 36 MeV ^{3}He ion beams at the compact cyclotron CV28 of the Forschungszentrum Jülich GmbH.

The excitation function of the reaction ^{100}Ru(α,n)^{103}Pd has a bell like form and the maximum cross section value lies around 500 mb at 17-18 MeV bombarding energy. The cross section of the ^{101}Ru(α ,2n)^{103}Pd reaction increases sharply with the increasing incident α-particle energy and reaches a high value of ∼1100 mb at 23 MeV. The integral thick target yield of ^{103}Pd calculated from the excitation function of the (α,n)-reaction amounts to 960 KBq/μAh at 25 MeV and that from the (α,2n)-reaction to 1050 KBq/μAh at 23 MeV.

The excitation function of the reaction ^{102}Ru(^{3}He,2n)^{103}Pd shows the maximum cross section value (∼300 mb) at the incident energy of 17-18 MeV and has a high energy tail with values 30-40 mb, while the ^{101}Ru(^{3}He,n)^{103}Pd reaction has a constant cross section of about 10 mb over the whole incident energy range studied. This behaviour is in accordance with the known systematic observation for such kind of reactions. The thick target yields of ^{103}Pd calculated for the last two reactions amount to 725 KBq/μAh and 50 KBq/μAh, respectively, at 34 MeV ^{3}He ion energy. So from the investigated reactions the reaction ^{101}Ru(α,2n)^{103}Pd may be considered to be the most suitable. In comparison to the presently used the (p,n)-reaction, however, the yield via the (α,2n)-reaction is by a factor of 8 smaller.

Email: skakun@kipt.kharkov.ua